

Expedition Earth and Beyond: Using Crew Earth Observation Imagery from the International Space Station to Facilitate Student-Led Authentic Research. P.V. Graff¹, W.L. Stefanov¹, K.J. Willis¹, S. Runco², ¹Jacobs Technology ESCG/NASA Johnson Space Center, Houston, TX, 77058, (paige.v.graff@nasa.gov), ²NASA Johnson Space Center, Houston, TX, 77058.

Student-led authentic research in the classroom helps motivate students in science, technology, engineering, and mathematics (STEM) related subjects. Classrooms benefit from activities that provide rigor, relevance, and a connection to the real world. Those real world connections are enhanced when they involve meaningful connections with NASA resources and scientists. Using the unique platform of the International Space Station (ISS) and Crew Earth Observation (CEO) imagery, the Expedition Earth and Beyond (EEAB) program provides an exciting way to enable classrooms in grades 5-12 to be active participants in NASA exploration, discovery, and the process of science.

EEAB was created by the Astromaterials Research and Exploration Science (ARES) Education Program, at the NASA Johnson Space Center. This Earth and planetary science education program has created a framework enabling students to conduct authentic research about Earth and/or planetary comparisons using the captivating CEO images being taken by astronauts onboard the ISS. The CEO payload has been a science payload onboard the ISS since November 2000. ISS crews are trained in scientific observation of geological, oceanographic, environmental, and meteorological phenomena. Scientists on the ground select and periodically update a series of areas to be photographed as part of the CEO science payload. Over a million astronaut photographs are available through the Gateway to Astronaut Photography of Earth website (<http://eol.jsc.nasa.gov>). This site receives millions of hits indicating the excitement generated by the public in viewing these images. EEAB uses astronaut photographs provided by the CEO payload as the premise of developed activities, resources, and program components facilitating student-led research. These components include: 1) Standards-aligned curricular resources, 2) Student use and involvement in CEO data collected through the ISS, 3) Student engagement with scientists, and 4) Educator professional development.

EEAB has developed two categories of standards-aligned, inquiry-based curricular resources. "Launchpad" activities are stand-alone activities designed to promote and spark an interest for student-led investigations of Earth and/or planetary comparisons. These activities can be used over 3-5 days, allowing students to grasp content and apply knowledge to more complex situations. These activities are written using the 5-E model of inquiry enabling students to build on prior knowledge, deepening their understanding of content and enhancing academic skills. "Student-Led Investigation" resources involve an even greater in-depth educational experience that can last from 3 weeks to a semester or longer, depending on the student research team. These resources include the EEAB Student Scientist Guidebook and the EEAB Student Wiki. Through the use of these materials, teams develop a research question, create an experiment design, gather data, analyze data, and draw conclusions. These materials

enable students to take charge of their research and realistically model the process of science.

Through the use of CEO imagery, interest and connection to viewing our home planet from space helps students spark questions that drive them to pursue research investigations. These data also form a basis for comparisons to the exploration of other planetary bodies in our solar system. EEAB provides the opportunity for participating student teams to be actively involved in CEO data collected by submitting new data requests. Student team data requests are reviewed and approved requests are included as CEO targets sent up to astronauts on the ISS. Student involvement in imagery being acquired by the CEO payload and contributions to science being conducted from the ISS provide motivation, inspiration, and valuable educational experiences to students.

Student teams conducting research through EEAB have the opportunity to work with a scientist and/or STEM expert as a team mentor. Mentors communicate with teams to provide guidance, feedback, and encouragement on student research. Mentoring takes place through the use of an online team workspace wiki. Teams model the process of science and post the progress of their research on their team wiki as they conduct their investigation. Communication and feedback from mentors helps enhance student research skills. It also allows students to be introduced to exciting potential career opportunities as they learn about missions and activities their mentor is involved with as part of their professional career. Student teams also have the opportunity to present their research to scientists. These virtual student team presentations are facilitated through the use of WebEx, an easy-to-use online conference tool that only requires an internet-connected computer and a speaker phone. Team presentations enable students to share their research with other teachers, students, and school administrators in addition to professional Earth and planetary scientists. The opportunity for students to share their investigation with others, particularly NASA scientists, is especially motivating.

To enable teachers to gain experience with EEAB resources and understand the value of data being obtained through the ISS, educator professional development (PD) is provided in two ways. In-person educator workshops are facilitated through local, regional, and national educator conferences. Online teacher trainings are also provided to enable educators to receive training without the expense of travel to conferences. These PD opportunities train and familiarize educators with curricular material, while increasing teacher content knowledge. They also enhance teacher skills and knowledge of inquiry-based strategies leading to authentic research in the classroom through the use of ISS data.

The Expedition Earth and Beyond program promotes the ISS and NASA's unique ability to inspire, engage, and educate students while enabling classrooms nationwide to be active participants in NASA exploration, discovery, and the process of science. The program enables classrooms to contribute to science and science activities accomplished from the ISS as they conduct student-led research and engage with scientists. This involvement raises and sustains interest in NASA and the ISS contributions to the understanding and exploration of our Earth and beyond. It also

helps provide powerful, motivating, authentic educational experiences that help students gain the skills necessary to be science-literate citizens and become NASA's next generation of scientists and explorers.